Title

The impact of nurse practitioner services on cost, quality of care, satisfaction and waiting times in the emergency department- a systematic review.

Abstract

Aims: To provide the best available evidence to determine the impact of nurse practitioner services on cost, quality of care, satisfaction and waiting times in the emergency department for adult patients.

Background: The delivery of quality care in the emergency department is emerging as one of the most important service indicators in health delivery. Increasing service pressures in the emergency department have resulted in the adoption of service innovation models: the most common and rapidly expanding of these is emergency nurse practitioner services. The rapid uptake of emergency nurse practitioner service in Australia has outpaced the capacity to evaluate this service model in terms of outcomes related to safety and quality of patient care. Previous research is now outdated and not commensurate with the changing domain of delivering emergency care with nurse practitioner services.

Data sources: A comprehensive search of four electronic databases from 2006-2013 was conducted to identify research evaluating nurse practitioner service impact in the emergency department. English language articles were sought using MEDLINE, CINAHL, Embase and Cochrane and included two previous systematic reviews completed five and seven years ago.

Review methods: A three step approach was used. Following a comprehensive search, two reviewers assessed all identified studies against the inclusion criteria. From the original 1013 studies, 14 papers were retained for critical appraisal on methodological quality by two independent reviewers and data were extracted using standardised tools.

Results: Narrative synthesis was conducted to summarise and report the findings as insufficient data was available for meta-analysis of results. This systematic review has shown that emergency nurse practitioner service has a positive impact on quality of care, patient satisfaction and waiting times. There was insufficient evidence to draw conclusions regarding outcomes of a cost benefit analysis.

Conclusion: Synthesis of the available research attempts to provide an evidence base for emergency nurse practitioner service to guide healthcare leaders, policy makers and clinicians in reform of emergency service provision. The findings suggest that further high quality research is required for comparative measures of clinical and service effectiveness of emergency nurse practitioner service. In the context of increased health service demand and the need to provide timely and effective care to patients, such measures will assist in evidence based health service planning.

Keywords: review, nurse practitioners, emergency service, quality of health care, patient satisfaction.

What is already known about the topic?

- There is limited evidence evaluating the effectiveness of the emergency nurse practitioner role in the current emergency department context.

- Previous reviews are now out-dated and it is essential for the evaluation of the evidence regarding emergency nurse practitioner service effectiveness and quality.
- The nurse practitioner role has evolved from a need to fill medical shortages, to an alternative model of care that can positively impact patient quality of care

What this paper adds?

- . The delivery of quality of care in the emergency department is one of the most important service indicators to be measured in health services today.
- In the context of increased emergency service demand and the need to provide timely and effective care to patients, this review will assist in evidence-based health service planning that will further add to the sustainability and development of the role.
- This review has shown that emergency nurse practitioner service has a positive impact on quality of care, patient satisfaction and waiting times. There is insufficient evidence to draw conclusions regarding outcomes of a cost benefit analysis.

Main text

Introduction

Overcrowding, access block, the growing burden of chronic diseases in the community and reduced access to primary healthcare have all contributed to increased demand for emergency department services (Health Workforce Australia, 2012, Sprivulis et al., 2006, Lowthian, 2011). Increasing service pressures have resulted in the adoption of innovative service models; the most common and rapidly expanding of these is emergency nurse practitioner service. Evidence evaluating the effectiveness of the emergency nurse practitioner role has previously been found

to be, ill-defined and the methodologically quality is considered to be fair to poor (Wilson et al., 2009). Clinical relevancy to the current emergency department context is essential for evaluation of emergency nurse practitioner service effectiveness and quality.

Background

Promoting the concept of healthcare reform and active consumer involvement, advanced nurse practice roles were developed to improve the quality of clinical care (Comiskey, 2013) . The nurse practitioner is one such role providing a service model that claims to offer flexibility and adaptation to the changing needs of the consumer population, but there are scant robust evaluations to date on the effectiveness of these roles. The nature of the nurse practitioner role involves a hybrid advanced nursing model of care which includes a combination of nursing care, diagnostic activities, intervention-based treatments and the use of medicines; some of these activities have traditionally been limited to the scope of medical practitioners (Gardner et al., 2010).

The emergence of nurse practitioner services globally was, in the USA and Canada over 40 years ago, to augment a shortage of primary care physicians (Silver et al., 1967, Kleinpell, 2012) in under-serviced areas. As a result of lack of primary care access for patients, nurses expanded their scope of practice through education and credentialing to meet population needs (Ridgway, 2012). Nurse practitioners now work in a myriad of settings providing care across primary, secondary and tertiary contexts (American Association of Nurse Practitioners, 2011). As nurse practitioner services have developed, sub speciality areas such as emergency, cardiovascular, endocrinology and oncology have adopted the nurse practitioner role for the delivery of high quality patient care (American Academy of Nurse Practitioners, 2010). The nurse practitioner role in Australia was first developed in 1994 with a pilot project to address feasibility within the health context (Currie et al., 2007). Since this inception, there are now over 1000 endorsed nurse practitioners, protected by title legislation and working to generic competency standards that govern practice across a variety of clinical settings (Nursing and Midwifery Board Australia, 2014).

Measuring the quality of patient care in the emergency department is emerging as one of the most important service indicators in Australian health services today. Emergency departments have seen more than 7% growth in patient presentations over the last 5 years and this has contributed to an ever-growing burden on the delivery of quality patient care (Lowthian and Cameron, 2012). The capacity of emergency departments to deliver timely, high quality and consistent patient care is impacted by the increase in the number and complexity of presentations (Lowthian and Cameron, 2012). Emergency department overcrowding is seen as the greatest single impediment to safe and efficient emergency services in Australia and New Zealand (Cameron et al., 2009) significantly resulting in increasing waiting times, adverse events, mortality and hospital length of stay (Forero et al., 2010). National clinical indicators for emergency department service delivery are government mandated and designed to monitor, analyse and evaluate a health service's performance (Department of Health Victoria, 2012). There are defined clinical indicators compiled by the Australian Council of Healthcare Standards (ACHS) to provide clinical perspectives on trends in service and measures to improve quality and safety of patient care. Emergency department overcrowding has resulted in the clinical quality indicators of waiting times, length of stay, time to analgesia and mortality becoming adversely affected and impacting effectiveness of patient care (Lowthian and Cameron, 2012).

Major recommendation from the Australian Health Workforce Advisory Committee's evaluation of emergency department models of care (Australian Health Workforce Advisory Commitee, 2006) was the need to address service issues in the emergency department with innovative models and workforce reform. Implementation of emergency nurse practitioner service is part of a reformative model of health service that has the potential to directly impact service outcomes and quality of patient care (Wilson et al., 2008).

The rapid uptake of emergency nurse practitioners internationally has outpaced the capacity to evaluate this service model in terms of outcomes related to safety and quality of patient care. For example, the emergency nurse practitioner model is the fastest growing nurse practitioner model in Australia, with a 61% increase over a three years period (Middleton et al., 2011). With increasing patient demands for service, and health care reform high on the government agenda, the provision of quality care and health service performance needs to be addressed.

There is a significant gap in the international research evaluating the effectiveness of emergency nurse practitioner services on waiting times, cost, quality of care and patient satisfaction. Carter and Chochinov (2007) and Wilson, Zwart, Everett and Kernick (2009) synthesised the evidence in the form of two systematic reviews exploring clinical effectiveness of nurse practitioners in the emergency department setting. Wilson et al.'s (2009) meta-analysis of pooled data from 55 studies, showed no significant differences in the clinical effectiveness of nurse practitioners to mainstream management of minor injuries ($p<0.05$). Carter and Chochinov's (2007) narrative synthesis of available evidence suggested that nurse practitioners services can reduce waiting times for the emergency department, lead to high patient satisfaction and provide a quality of care equal to that of a mid-grade resident medical officer. When comparing the cost of emergency nurse practitioner services with resident physicians it was determined that nurse practitioner services were more expensive. The results confirmed earlier findings from US and UK studies where the role has been established for several decades (Sakr et al., 1999, Cooper et al., 2002, Barr, 2000, Mabrook, 1998, Asubonteng, 1995, Byrne, 2000). With the increasing uptake of emergency nurse practitioner service internationally since the previous reviews, coupled with imperatives for emergency department service improvement, it is timely to re-examine the evolving evidence on clinical and service effectiveness of emergency nurse practitioner services for today.

The review

Aim

Systematic reviews provide a rapid overview of the significance of the research topic and an evaluation of the quality of the individual studies included in the review (Ressing, 2009). This systematic review was conducted to determine the best available evidence related to the impact of emergency nurse practitioner services on cost, quality of care, satisfaction and waiting times in emergency departments. This review will consolidate the evidence presented previously by Carter and Chochinov (2007) and Wilson et al. (2009) and review the new literature from 2006 to 2013.

Design

A systematic review with a narrative analysis was conducted to locate, retrieve and evaluate the international evidence on effectiveness of emergency nurse practitioner service (Ressing et al, 2009). A detailed study protocol, analysis plan and a prospectively defined inclusion and exclusion criteria was developed by the review team. Due to the heterogeneity of the available research and lack of complete and comparable statistical data, a narrative synthesis of study findings was conducted with a quantitative summary of the results included. Critical appraisal tools, the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI), were used.

Search Strategy

The systematic reviews published in 2007 and 2009 were considered to be comprehensive and hence the new search strategy for this review was mandated from the 2007 paper methodology to include all articles and all new evidence that would not have been reflected upon in the original two reviews. It was also considered that the healthcare context and evolving role of emergency nurse practitioner services had also moved

forward from this previous era and would no longer be considered valid for this review. A comprehensive search strategy was undertaken in May 2012 and again in March 2013 to locate both published and non-published studies from 2006 to 2014. A search of the literature was undertaken by developing a concept map to recognise all the key subject words and concepts. The corresponding author of the previous systematic review published in 2007 (Carter et al., 2007) was contacted to share search strategy techniques from the initial review. A three-step search strategy was formulated to identify the literature gained through the strategy that included keyword, subject and grey literature searching. Initial keyword terms used were combined to yield our search results. The key search terms are shown in Table 1. MeSH terminology and keywords were adapted to suit the needs of each database searched.

An initial search included identifying synonyms of the keyword terms utilising each databases' thesaurus options to ensure all terms were broad enough to capture the research pertaining to the field of emergency nurse practitioner service outcomes. The databases searched were MEDLINE, CINAHL, Embase and Cochrane.

Table 1. Summary of the themes and key words employed in the literature review

Key themes	*Role title*	*Setting*	*Effectiveness*
	nurse practitioner*	Emergency department	Outcome and processes
	Advanced practice nurs*	accident and emergency	results
	nurse clinician	emergency medical	benefits
	nurse consultant	service*	deliverables
		emergency	quality of health care
		casualty	evaluation
		emergency room	impact*
		minor injury clinic	efficien*
			follow up studies
			quality assurance

	treatment outcomes
	nurs* outcomes
	cost
	satisfaction

A second extensive search using all identified keywords and subject terms was then undertaken using all of the databases. A further electronic search of Google, Google scholar and health department websites internationally for nurse practitioner published works, reports or additional research was also conducted.

Inclusion Criteria

Published and unpublished English language studies which met the following criteria, were eligible for inclusion in the review

Table 2 Inclusion Criteria using PICO format

P (population)	All facilities with defined emergency services, i.e.: Minor injuries clinic, walk in centers, emergency departments, accident and emergency, casualty, primary care clinics. Adult male and female patients and ethnicity.
I (intervention)	Nurse practitioner services conducted on site.
C (comparisons)	Traditional emergency department clinical services that do not include nurse led care, only medical lead services (comparator).
O (outcomes)	The primary outcomes are impact of nurse practitioner services (intervention)

	on ○ cost ○ waiting times ○ patient satisfaction ○ quality of care

There are many definitions of the nurse practitioner role internationally. Hence the term nurse practitioner is often used interchangeably with advanced practice nurse, registered nurse, acute care nurse practitioner, family nurse practitioner, nurse registrar, nurse consultant and nurse practitioner candidate. In Australia the term nurse practitioner is title protected by national legislation and less ambiguity exists in local literature regarding its definitions (Nursing and Midwifery Board Australia, 2010). All definitions were considered during the search strategy and then hand reviewed for identification of the appropriate use of the term nurse practitioner.

Search outcome

The reference lists of all identified abstracts were also searched for additional material not already located. The initial search of the above strategy yielded 1013 articles. These articles were then hand reviewed by the primary author for relevance to the aims of the review. Retained articles were then assessed for relevance to the review based on the title and the abstract using the inclusion /exclusion criteria. Articles identified as potential for inclusion were then retrieved yielding a total of 84 articles. A two-person review process was then undertaken to identify the final articles for review. Based on the assessment of the full text, those studies of poor methodological quality, and those that did not meet the inclusion criteria were excluded from the review. Fourteen studies were included in the review examining nurse practitioner service

impact on cost, quality of care, satisfaction and waiting times. Two articles were disputed in the two-person review process and sent to a third reviewer for analysis (Figure 1). The PRISMA flow diagram has been utilised to demonstrate the flow of information through the different phases of the review (Moher, 2009).

There was consensus in the review team that 14 papers met the inclusion criteria (Table 2). Two of the 14 papers were considered to be of the highest level of evidence, as they were systematic reviews (National Health and Medical Research Council, 2000). There were two quasi-randomised controlled trials and the remaining 10 studies were observational descriptive designs that included retrospective audit, case control and case series.

Quality appraisal

Two independent reviewers using standardised data extraction tools adapted from the Johanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) assessed the quality of the included studies. Any disagreement was resolved by discussion between the two reviewers and sent to a third reviewer for mediation if required. The quasi-randomised trials were evaluated to determine assignment of randomisation, blinding, allocation concealment, validation of study tools, intention to treat principles and study limitations. The remaining descriptive studies were appraised using the same approach to quality and to determine differences between populations, comparators to the intervention and resultant outcomes. All data extracted included specific details about the interventions, populations, study methods and outcomes of significance in relation to the impact of emergency nurse practitioner services on cost, quality of care, satisfaction and waiting times in emergency departments. The findings from the studies were then summarised by two reviewers and then combined to form the narrative review.

Data abstraction

Data was extracted from each of the 14 included studies and presented in Table 3. Summary of the aims and methodology, participants, outcomes and results for each study was tabled. Data was extracted by one reviewer and checked by a second reviewer for accuracy. Table 4 is a synthesis of the results of the included studies.

Insert table 3 here.

Results

Cost

From the 14 papers included in the review, only one directly examined cost of delivery of emergency nurse practitioner services and their comparison to the same / similar service provision by medical and extended scope physiotherapist personnel. McClellan et al. (2013), in their randomised pragmatic trial of equivalence, measured costs in management of the soft tissue injury patient cohort. The authors acknowledge the significant limitations of the study being limited to one site with small nurse practitioner numbers and question the extent to which findings could be generalised. The overall outcome was that cost of soft tissue injury management was equal between medical, nurse practitioner and extended scope physiotherapist services.

Quality of care

The effectiveness of emergency nurse practitioner services on quality of care was poorly defined in the review with only one study using the term as an outcome measure (Dinh et al., 2012). A convenience sample of patients was randomised to either medical or the emergency nurse

practitioner care in the fast track unit of the participating emergency department. Quality of care was measured using a combined score from patient satisfaction; follow up health status and adverse event rates. This was a well-designed study that demonstrated overall quality of care rating of emergency nurse practitioner care at 68% compared with 50% for the medical care group ($p<0.020$). In particular there was some evidence to suggest the overall care rating categorised were significantly different between the emergency nurse practitioner service group and medical officer service group of patients. The emergency nurse practitioner patient group rated their care as excellent compared with the medical care patient group (68% vs. 50%, fisher's e exact $p< 0.02$).

Measures utilised throughout the other studies that are often used interchangeably with quality of care definitions, included accuracy of X-ray interpretation, unexpected patient returns, missed injuries rates, inappropriate management of patients, unscheduled returns to emergency department and percentage of patients whom do not wait for treatment (Nash, 2006, Colligan et al., 2011, Dinh et al., 2012, Lee, 2013). Fry et al.'s (2011) study demonstrated a reduction the number of patients' whom did not wait for treatment during service delivered by the nurse practitioner service. Nash et al.'s (2006) study showed a rate of unscheduled returns for emergency nurse practitioner patients of 2.3% compared with 4.2% for the medical patients. Colligan et al. (2010) demonstrated similar figures of 2% for the emergency nurse practitioner patient group and 1% for the medical registrar patient group. Missed injuries and inappropriate management were also examined in Colligan et al.'s (2010) study. No significant difference was found between the emergency nurse practitioner service and physician service groups.

Satisfaction

Patient satisfaction for care delivered by emergency nurse practitioner services was explored in Dinh et al.'s (2013) observational study. The study used a convenience sample of emergency patients randomised to assessment and treatment by an emergency nurse practitioner or an emergency medical officer. Satisfaction surveys were completed by 236 patients presenting to the emergency department and comparisons made

between randomised treatment groups of either an emergency nurse practitioner (n=133) or the next available emergency medical officer (n=103). Findings showed that improved quality of care, reduced waiting times and consequently higher patient satisfaction levels were all apparent in the emergency nurse practitioner service group. When satisfaction scores were adjusted for waiting time the emergency nurse practitioner service still maintained a 1.5 x higher mean total satisfaction score (beta coefficient = 1.5, p = 0.004, 95% CI, 0.48-2.5).

These results are supported by the study conducted by Jennings et al. (2009) utilising a similar sample size. Jennings et al.'s (2009) observational survey of 202 emergency department patients reported significant differences in levels of satisfaction between patients assigned to emergency nurse practitioner care and emergency department physician care. Out of the 16 questions, responses to 12 demonstrated a significant between the two groups in favour of the emergency nurse practitioner services ($p<0.005$). The survey questions related to the health professional being interested in the person, being thorough, the patient being less worried about their health after seeing the health professional and having enough time to discuss concerns in detail.

Nash et al.'s (2006) report on patient satisfaction with care management in a new fast-track unit staffed only by emergency nurse practitioners, surveying 90 emergency department patents. Patients were asked six questions as part of a patient satisfaction questionnaire and the results aligned with demographic data collected from historical records. The research reports that 100% of patients seen by emergency nurse practitioner services in the fast-track area scored their care as good or excellent.

Waiting times

Waiting time analysis was well reported and homogenous amongst the included papers. Of the 14 papers, nine explored emergency nurse practitioner services' impact on waiting times. In the most recent study by McClellan et al. (2012), a randomised pragmatic trial of equivalence,

showed a similar wait time profile for patients managed by the emergency nurse practitioners in comparison to medical officers and extended scope physiotherapists . In contrast, Dinh et al. (2012) reported that patients managed by emergency nurse practitioners trended to shorter waiting times when compared with medical officers, with a difference of seven minutes (p=0.06). Colligan et al.'s (2011) prospective observational audit demonstrated a significant reduction in waiting time for patients managed by the emergency nurse practitioners in comparison to the emergency department medical registrars; emergency nurse practitioners 14 minutes (range 5-27) vs. emergency department medical registrars 50 minutes (range 21-78) ($p<0.0001$). This is also supported by Jennings et al.'s (2008) large case series which clearly showed a significant reduction in waiting times for patients managed by the emergency nurse practitioners service, 12 minutes (range 5.5 – 28 minutes), in comparison with traditional medical service,31 minutes (range 11.5 – 76 minutes), ($p<0.001$). Waiting times reduction was also reported by Fry et al (2011), Van Der Linden et al (2010) and Considine et al (2010).These results are consistent with the evidence presented in the preceding systematic reviews (Carter and Chochinov, 2007 and Wilson et al, 2009).

Some of the study settings were collaborative models of care that encompassed both emergency physicians and emergency nurse practitioner care and hence their outcomes of waiting times are difficult to interpret. Steiner et al.'s (2009) study used a collaborative model that demonstrated no significant differences in overall median waiting times, but also showed increased patient throughput with larger numbers of patient presentations being seen when the emergency nurse practitioner service was available. Considine et al.'s (Considine et al., 2006) case control study results are also difficult to synthesise. This study included only one emergency nurse practitioner candidate (a candidate has not yet completed the requirements to be endorsed as a nurse practitioner) and formed part of the evaluation of the implementation of the new service in this setting.

Insert table 4 here

Discussion

There is a paucity of evidence exploring the impact of emergency nurse practitioner services on cost, quality of care, satisfaction and waiting times in the emergency department. The lack of well-controlled studies evaluating these outcomes resulted in the inclusion of study designs other than randomised control trials necessitating narrative reporting of findings. The overall quality of the included studies was also difficult to compare due to the varying operational definitions in role titles, scope of practice and levels of interventions. Additional difficulties were found the small sample of emergency nurse practitioners in the often-single site observational designs.

Reliable evidence on the outcome measure of cost effectiveness is considered a major influence on service planning for expansion of emergency nurse practitioner services (Hollinghurst et al., 2006, McClellan et al, 2013,). Results from the one study in this review that directly examined the cost of delivering emergency nurse practitioner service compared with medical and extended scope physiotherapist services (McClellan et al., 2012), require careful consideration. Interpreting equivalence of cost between these three different service providers requires a greater analysis regarding the type of funding model, role descriptions and a cost benefit analysis. Varying economic models fund emergency department budgets and hence direct comparisons to the UK, USA and Australian settings is problematic.

Emergency nurse practitioner services have shown to improve the performance indicators that directly impact patient quality of care (Wilson et al., 2009; O'Connell and Gardner, 2012, Omachonu, 2010). However the concept of quality of care, and specifically the definitions of quality patient care in the emergency department, has produced considerable debate within the literature (Lowthian and Cameron, 2012, O'Connell and Gardner, 2012, Cameron et al., 2011). Previously, emergency department patient care was considered to be of varying quality and ill defined (Cameron et al., 2011). In November 2011, the International Federation for Emergency Medicine developed a framework to provide a platform

to underpin the pursuit of quality and safety in all emergency departments. The framework lists domains of quality patient care that encompass the delivery of safe, effective, patient-centred, timely, efficient and equitable health care to all patients (International Federation of Emergency Medicine, 2012). This review clearly demonstrates quality of care in emergency nurse practitioner services, is hard to define, ambiguous and not used routinely as a measure of the service effectiveness. Dinh et al.'s (2013) study was unique in that it incorporated three of the defined features of quality care as measures of service effectiveness; patient satisfaction, follow up health status and adverse effects. Other studies have used accuracy of X-ray interpretation, unexpected patient returns, missed injury rates, inappropriate management of patients and unscheduled returns to emergency department as measures of quality of care when reviewing or comparing emergency nurse practitioner service (Nash et al., 2006, Colligan et al., 2011, Dinh et al., 2012, Lee et al., 2013).

Satisfaction with emergency nurse practitioner service is an important consideration in relation to service effectiveness. There appears to be a good body of evidence in favour of a significant impact of emergency nurse practitioner services on patient's satisfaction (Jennings et al., 2009, Dinh et al., 2012, Nash et al., 2006). Patients' are viewed as consumers of healthcare and there is a greater emphasis on ensuring that the patient's health care experience is valued (Muntlin, 2006). The majority of studies examining patients' satisfaction are single sites and consist of self-administered questionaries that patients complete following their emergency department encounter (McMullen, 2001, Roblin, 2004, Cooper et al., 2002, Bryne et al., 2000 and Jennings et al., 2009). The review has demonstrated consistently a trend in favour of high levels of patients' satisfaction with emergency nurse practitioner services (Sandhu, 2009, Hoskins, 2011, Byrne et al., 2000, Mabrook and Dale, 1998, Hoskins, 2011). A common element from all studies is no reduction in patient satisfaction with emergency nurse practitioner service compared with medical service and anecdotally a greater holistic approach to discharge instructions and health education (Jennings et al., 2009, Nash et al., 2007, Dinh et al., 2013). Much of the literature shows that a patient's satisfaction is closely linked with emergency department waiting times (Boudreaux, 2004, Nash et al., 2006).

Waiting times for care to be delivered in the emergency department is a key performance indicator of service efficiency used throughout contemporary emergency settings. Significantly increasing waiting times can have impacts on patient care with increased adverse events, mortality and hospital length of stay (Forero et al., 2010). Due to increasing service issues such as overcrowding, increased demand and the challenges of meeting time performance targets (National Health Performance Authority, 2013), emergency departments are focusing on the ability to deliver timely and efficient healthcare to patients. Emergency nurse practitioner services appear to have had significant impact on waiting times for patients to be assessed (Carter et al., 2007, Considine et al., 2010, Fry et al., 2011, Steiner et al., 2009, Van der Linden et al., 2010, Colligan et al., 2011, Jennings et al., 2008 and Dinh et al., 2013) and consequently improved access for patients in several of these key performance targets. Recently implemented National Emergency Access Targets (NEAT) in Australia and elsewhere, have forced health services to re-evaluate their delivery of care and evaluate service models. Time-based performance targets such as waiting times are now utilised to compare and contrast health service efficiency.

Limitations

This current review provides a timely appraisal of the status of research evaluating the effectiveness of emergency nurse practitioner services. The ability to calculate a pooled effect of estimates on the impact of nurse practitioner services on cost, quality of care, satisfaction and waiting times would have been invalid for a number of reasons. There are many potential confounders in the studies reported and hence due to the heterogeneity of the available research only a narrative synthesis of the results could be included. This review was impeded by the paucity of available research that examined the effectiveness on emergency nurse practitioner service on key outcome measures such as cost, quality of care, satisfaction and waiting times. Since 2006 there has been limited enquiry into an expanding emergency nurse practitioner service and the impact on safety and quality of patient care. The major limitation in all of the studies in the review includes the varied definitions used to define

and describe the role of the emergency nurse practitioner. None of the studies provided stable operational definition for emergency nurse practitioners. The lack of operational definition for emergency nurse practitioners to differentiate the service from other advanced practice nursing roles leads to considerable international confusion and prohibits cross border comparisons. The variability of the clinical skills and theoretical knowledge for the nurses participating in the above studies is a significant limitation.

Any additional clinical workforce added to an emergency department model of care can often be linked to reduction in waiting times, due to the nature of an extra practitioner. This factor was not controlled for in any of the review studies. The implementation of emergency nurse practitioner services and whether they have evolved from nurse or medical substitution results from local needs. Nevertheless any innovation in emergency department service delivery that impacts patient quality of care needs to be examined.

Conclusion

Not-with-standing the above limitations, the narrative findings from this systematic review suggest that emergency nurse practitioner services do impact patient satisfaction and waiting times positively. Cost effectiveness of emergency nurse practitioner service was shown to be equal to that of other health professionals in regards to soft tissue management and overall quality of care was higher within emergency nurse practitioner service. However the impact of the emergency nurse practitioner service on emergency department patient care delivery needs to be evaluated by robust research to produce evidence that informs healthcare policy and service developments. This will in turn provide context for further studies and provide an evidence base for healthcare leaders to ensure sustainability and ongoing service reform models.

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Table 3: Included studies objectives and measurements.

Study	*Aims*	*Data collection Methods*	*Participants*	*Outcomes*
McClellan et al (2012)	To investigate the clinical effectiveness of extended scope physiotherapists, emergency nurse practitioners and doctors, who independently manage minor injuries in a United Kingdom Emergency Department.	Randomised pragmatic trial of equivalence using a questionnaire attached to patients notes completed by treating practitioners, outlining treatment and process measures and follow up. Follow up was assessed by telephone interviews at 2 and 8 weeks post discharge.	All adults >16 years presenting with a peripheral soft tissue injury eligible for management by any of the three groups. 372 patients provided consent and were randomised, 126 to extended scope physiotherapists group, 123 to emergency nurse practitioner group and 123 to doctor group.	The primary outcome measure was functional recovery. Primary outcomes were assessed using a Disability of the Arm, Shoulder and Hand (DASH) scoring tool and a Lower Extremity Functional Score scoring tools. Secondary outcomes measured were quality of life, health utility score and number of days unable to work. Additional outcomes reported include time spent with each practitioner, the frequency with which various treatments and drugs were used and subsequent contact with other healthcare providers.
McClellan et al (2013)	To investigate the cost effectiveness of emergency nurse practitioners and extended scope physiotherapists with routine care by doctors	Randomised pragmatic trial of equivalence using a questionnaire attached to the patients notes completed by treating practitioners, outlining treatment and	All adults >16 years presenting with a peripheral soft tissue injury eligible for management by any of the three groups. 372 patients provided consent and were randomised, 126 to	Main outcome measures were economic cost evaluation from a funder perspective capturing the direct, indirect and intangible costs in primary and secondary care associated with patient care episodes. Primary outcome were cost per hour of patient contact and cost per patient per hour. This was calculated by

	when treating soft tissue injuries in a single United Kingdom emergency department.	process measures. Plus follow up telephone interviews using a questionnaire. Full methodology was not outlined in this paper but in the companion paper listed above.	extended scope physiotherapists group, 123 to emergency nurse practitioner group and 123 to doctor group.	dividing the salary cost of the different professional groups by their productivity i.e. numbers of patients treated per hour. Secondary outcomes were the indirect cost per hour of patient contact and the indirect costs of care per hour of patient contact.
Dinh et al (2012	Primarily a study of the overall quality of care delivered by a fast track unit and secondly to compare quality of care provided by a dedicated emergency department nurse practitioner and emergency doctors.	Patients enrolled in the study completed a patient satisfaction survey immediately post treatment, follow up surveys were completed two weeks following discharge from the hospital.	Patients aged between 16 and 70 years presenting to fast track when the nurse practitioner was working. 320 patients enrolled, 155 seen by doctors and 165 seen by the nurse practitioner.	Primary outcome was quality of care using patient satisfaction scoring, patient satisfaction scoring adjusted for time waiting, patient health status perception two weeks post discharge and unplanned representations and missed fractures.
Colligan et al (2011)	To determine if nurse practitioners are as effective as Emergency Medicine Registrars in managing	Prospective observational chart audit of non-consecutive patients with minor trauma.	All adult >15 years patients seen during nurse practitioner working hours (0900-1930 7 days a week) Nurse	Primary outcome measure was LOS. Secondary outcomes were time to be seen, number of unexpected returns, missed injury rate and numbers of patients who left without being seen

	minor injuries in a New Zealand setting.	Chart review and data entry attended by an emergency nurse practitioner and emergency registrar.	practitioner group n=305 and doctor group n= 115. Median age nurse practitioner group 30 and doctor group 41.	
Fry et al (2011)	To describe patient demographics and conditions managed within a transitional emergency nurse practitioner model, evaluate the impact of the transitional emergency nurse practitioner model role on the delivery of emergency services and to examine the efficiency and safety of transitional emergency nurse practitioner model management.	A single institution prospective observational study over 12 months. Data on patient demographics, triage categories and conditions managed by Transitional Emergency Nurse Practitioners was collected from the emergency department information system and compared with patient flow through the department for the 12 months prior to the transitional emergency nurse practitioner model implementation.	3827 patients managed by transitional emergency nurse practitioner model = 10% of emergency department presentations. All data was collected from electronic emergency management program reports.	Patient demographics and conditions managed within the transitional emergency nurse practitioner model were analysed using descriptive statistics. The efficiency and safety of transitional emergency nurse practitioner model management was analysed by comparing wait times and length of stay for a random selection of diagnostic patient groups and then compared with those seen by doctors in the time leading up to implementation of the transitional emergency nurse practitioner model. Safety was evaluated by examination complaints and incidents pertaining to transitional emergency nurse practitioner model performance, auditing representations and checking of all transitional emergency nurse practitioner model radiological investigations by emergency physicians. The impact of the transitional emergency nurse practitioner model role on the delivery of emergency services was evaluated by comparing waiting times, did not wait events and

				length of stay for 1 year prior to transitional emergency nurse practitioner model and 1 year during implementation.
Van Der Linden et al (2010)	To compare care provided by nurse practitioners and junior doctors/senior house officers to patients with minor injuries and illnesses.	Descriptive retrospective cohort study. All data was collected from hospitals electronic patient database. Comparison of missed injuries, inappropriate management, waiting times and length of stay.	Sample of 741 patients managed by nurse practitioners and 741 patients managed by junior and senior doctors. All patients deemed low care	Groups compared regarding incidence and severity of missed injures and inappropriately managed cases, waiting time and length of stay.
Jennings et al (2009)	To explore patients' satisfaction with care provided by emergency nurse practitioners and emergency department doctors.	A self-administered 16 question survey about the patient emergency department experience including timing, education, follow-up, instruction.	All patients presenting to fast track area of emergency department during a 4 month period. 202 patients completed the survey, 103 seen by emergency nurse practitioners and 99 seen by emergency doctors.	Questionnaire responses indicated practitioner interest and understanding, patient confidence and reassurance from consultation, discussion thoroughness, and management, planning and family inclusion. Responses on a Likert scale were compared.

Steiner et al (2009)	To determine if a broad scope nurse practitioner in an emergency department would improve wait times, length of stay and left-without-treatment rates	Prospective observational study Data collected from the emergency department information system database was analysed using descriptive statistics.	Intervention shifts were those when a nurse practitioner was rostered in the emergency department, control shifts were those when only emergency physician was working. All patients registered in the ED during control and intervention shifts were eligible for analysis. 1325 patients seen by doctors and 379 autonomously by nurse practitioners and 220 and in collaboration.	Primary outcomes of patient wait times, length of stay and patients whom left-without-treatment were compared between nurse practitioner and doctor shifts.
Considine et al (2010)	To evaluate the effect of clinician designation on emergency department fast track performance	A retrospective audit of patients managed through an emergency department fast track unit.	All patients seen in Emergency Department Fast Track during a 12 month period. (n=8714).	Waiting times, in relation to recommendations in the Australian Triage Scale. Length of stay, for non-admitted patients.
Jennings et al (2008)	To assess the impact of the implementation of the emergency nurse practitioner candidate on waiting times and length of	Retrospective case series study of emergency department patients in common diagnostic subgroups. Data collected	Patients with Australasian Triage Scale 3-5 categories presenting to the emergency department between 0700-2330 all days except Tuesdays.	Primary outcome were; time waiting to be seen by a nurse practitioner candidate or a doctor and length of stay, and Disposition comparisons.

	stay for patients presenting to the emergency department compared with the traditional model of care	from emergency department patient information system and descriptive statistics were used to analyse the results.	(n=3156) 572 in the nurse practitioner candidate managed group and 2584 in the doctor managed group.	
Considine et al (2006)	To compare emergency department waiting times, treatment times and length of stay for patients managed by an emergency nurse practitioner candidate with patients managed by the traditional emergency department model of care.	Case control study	Patients were selected from the 3 most common emergency department discharge diagnoses for emergency nurse practitioner candidate managed patients. Hand/wrist wounds, hand/wrist fractures and removal of POPs. Emergency nurse practitioner group n=102. Control or traditional emergency management group n = 623.	Primary outcomes measured fell under the heading of patient flow. This was achieved though the comparison of waiting times, treatment times and length of stay between emergency nurse practitioner and doctor (traditionally) managed patients.
Nash et al (2006)	To evaluate the efficacy of a newly developed fast track unit staffed by nurse practitioners.	An explorative descriptive design utilizing retrospective electronic chart review and prospective patient satisfaction surveys and comparing the new fast	All patients attending the fast track unit between March and August 2003, n= 5995 comparison with the minor care treatment area patient presentations for the same	Primary outcomes were the measures of unscheduled returns, left without being seen, patient satisfaction, time in the emergency department and time in the treatment area.

		track unit with the replaced minor care treatment area.	period in the prior year, n=9130.	
Wilson et al (2009)	Systematic review		The best available evidence to determine the clinical effectiveness of emergency nurse practitioners in treating minor injuries. 9 studies including 2 randomised control trials from 55 papers in the literature search met the inclusion criteria.	Primary outcomes compared the clinical effectives of nurse practitioners to junior emergency doctor or mainstream management of minor injuries was determined with fair to poor methodological quality.
Carter and Chochinov (2007)	Systematic review		Articles that discussed nurse practitioners in the emergency department settings that addressed 1 or more of 4 outcomes: cost, quality, wait times and patient satisfaction. 36 papers were included	4 key outcome measures: wait times, patient satisfaction, quality of care and cost effectiveness. Determined inclusion and allowed for comparison

Table 4: Results and interpretations.

Study	*Results*	*Notes*
McClellan et al (2012)	Primary outcomes Functional recovery- emergency nurse practitioners and extended scope physiotherapists had equivalent outcomes to routine care provide by doctors 8 weeks post injury.	The study was limited to one United Kingdom emergency department, with relatively small numbers of practitioners, making generalisation of findings difficult.
	Secondary outcomes Nurse practitioners and extended scope physiotherapists were equivalent to routine care provided by doctors in all measures. Patients seen by emergency nurse practitioners had similar time profiles to doctors with extended scope physiotherapists having longer consultation times.	The follow up period was concluded at 8weeks post injury and important long term issues may be being overlooked in the findings. The authors acknowledge that further multicentre studies will increase the validity of their findings.

McClellan et al (2013)	Principal findings determined that the average cost per hour of patient contact was £80.91 for doctors, £89.71 for extended scope physiotherapists and £109.81 for emergency nurse practitioners. The direct costs per hour of patient contact was £60.96 for doctors, £52.48 for extended scope physiotherapists and £55.21 for emergency nurse practitioners it is the indirect costs that extended the average cost in each group, namely planned follow up, travel costs, additional items such as pain relief and bandages. The results demonstrated that both the extended scope physiotherapists and emergency nurse practitioner groups could not be cheaper than routine care provided by doctors: they are at best equivalent and possible more expensive.	Authors acknowledge the findings are unlikely to represent all the United Kingdom emergency departments and encourage a multicentre replication. Single emergency department with relatively small numbers of practitioners involved in the research. Indirect costs were only captured to eight weeks post injury; the true costs may extend far beyond this in some of the sample.
Dinh et al (2012	Significant difference between study groups in the overall care rating 68% for nurse practitioners vs. 50% for doctors (p=0.02) and slimily total satisfaction and total satisfaction adjusted for wait times remained statistically significant in favour of the nurse practitioner group, median score 23 in total satisfaction, compared with doctor group median score 21 in total satisfaction (p=0.002). Telephone responses to the general health component reported excellent health in the nurse practitioner group 31% vs. 13% in the doctor group (p=0.015). Physical component summary (PCS) and mental component summary (MCS) showed no	Australian study High quality care delivered by (only 1 emergency nurse practitioner at site), patient satisfaction higher but overall health outcomes and adverse events rates were similar at two week follow up. Strongly supports fast track unit structure.

	significant difference between nurse practitioner and doctor groups. (PCS 48 vs 47.6 p=0.78) (MCS 51.2 vs 51.7 p=0.58). Unplanned representations and missed fractures emergency nurse practitioner 9% group vs. 6% doctor group (p=0.22). Each group missed 1 fracture.	Single site low practitioner numbers.
Colligan et al (2011)	Time to be seen (median) nurse practitioner group14 minutes vs. 50 minutes in doctor group (p= <0.0001). Length of stay (median) 99 minutes nurse practitioner group vs. 139 minutes doctor group=<0.0001). Treatment times were equivalent. Missed fracture rate was equivalent 1%. Unexpected return rate was 2% in the nurse practitioner group and 1% in the doctor group. Left without being seen rate was 5% during the study time frame overall distribution of LWOS was 30% during nurse practitioner in the department time and 70% when no nurse practitioner was in the department.	New Zealand study at one site. Potential for selection bias of patients into each group. Significant difference in sample sizes per groups. Use of electronically recorded times may not reflect true flow through the emergency department.
Fry et al (2011)	Transitional emergency nurse practitioner model median wait time was 38 minutes compared with 59.7 minutes in the year prior to transitional emergency nurse practitioner model. Length of stay was 207minutes vs. 213minutes. (p=<0.0001). Random comparison of length of stay between transitional emergency nurse practitioner model patients and doctor patients for musculoskeletal diagnosis showed transitional emergency nurse practitioner median length of stay 33minutes vs. 53minutes in the doctor group (P=<0.0001). Did not wait when the transitional nurse practitioner model operational 4.5% vs. 8.1% in	Australian study. One site Data dependant on correct data entry by staff. Possible selection bias

	previous year. Representing transitional emergency nurse practitioner model rate was 3.3%.	
Van Der Linden et al (2010)	No statistically significant difference in missed injuries, inappropriate management, or waiting times between groups was found. The mean length of stay was significantly longer for junior/ senior doctors 85mins compared to emergency nurse practitioners 65 minutes (Confidence interval 95%).	Netherlands Single site Nurse practitioners restrained in types of patients able to treat, no ambulance or GP referrals, greater percentage of patients less than 5yrs.
Jennings et al (2009)	Significant differences were reported in 12 of the 16 questions ($p<0.05$) in favour of the emergency nurse practitioner care provided. These 12 answers related to the doctor or nurse practitioner being interested in the person, being thorough, the patient being less worried about their health after seeing the doctor or nurse practitioner and having enough time to discuss concerns in details. The remaining answers favoured towards the nurse practitioner model without statistical significance, these responses related to management and planning.	Australian study Single site, authors acknowledge greater validity in the findings might be obtained by combined multicentre study results.
Steiner et al (2009)	No significant difference for wait times, length of stay of left-without-treatment rates between nurse practitioner and emergency physician shifts was determined form the research.	Canadian study, many compounding factors that may have swayed data e.g. Bed block.
Considine et al (2010)	Clinician designation does impact on waiting times and length of stay for patients managed in fast track systems. Nurse practitioners maintained the highest compliance with Australasian Triage Scale	Australian Study Many variable results open to interpretation

	recommendations.	
Jennings et al (2008)	Statistically significant differences in waiting to be seen time and length of stay were evident favouring the emergency nurse practitioner candidate system. In wait time the medians compared nurse practitioner candidate group 12 minutes vs. 31 minutes in the traditional doctor managed group ($p<0.001$). In length of stay the medians compared nurse practitioner candidate group 94 minutes vs. 170 minutes in the traditional doctor managed group ($p<0.001$).	Australian study Possible data collection inaccuracies. No consideration for other influences on data collected e.g. Access block.
Considine et al (2006)	No significant differences in median waiting times, treatment times or length of stay between nurse practitioner candidate and doctor managed patients. There was some variability between diagnostic subgroups in terms of treatment times affecting emergency department length of stay.	Australian Study Acknowledges that patient flow outcomes do not independently or accurately reflect the effectiveness of an emergency nurse practitioner candidate program.
Nash et al (2006)	Unscheduled returns to the emergency department when first seen in the emergency nurse practitioner managed fast track unit was 2.3% compared to the overall emergency department return rate of 4.2% for the same period. Left without being seen rates were reported in the minor care treatment area at a rate of 6.7 % compared to the emergency nurse practitioner managed fast track unit at 3.9% ($p<0.001$). Patient satisfaction 100% for quality for care given by emergency nurse practitioner managed fast track unit as good or excellent. No significant difference between the emergency nurse practitioner managed fast track unit, 4.36hrs, and the minor care treatment area, 4.68hrs, for length of	USA Study Mixed comparisons between two treatment areas and overall emergency department statistics. Compared the patient flow s and satisfactions between an old well established unit and the first 3 months of operation of the new emergency nurse practitioner managed fast track unit. Dependant on data entered by clinicians at time of treatment.

	stay was determined. Statistical difference in treatment time of 1.97 hours for the emergency nurse practitioner managed fast track unit compared with 2.64 hours was minor care treatment area was shown.	
Wilson et al (2009)	No statistically significant differences between effectiveness of care of adults by emergency nurse practitioners and junior doctors. ($p<0.05$)	The authors acknowledge that findings were limited to the limited number of poor quality studies and recommend conclusions be viewed with caution. Further research is encouraged.
Carter and Chochinov (2007)	Many findings leading to the conclusions that emergency department nurse practitioners are more expensive than residents however total costing is difficult as most nurse practitioners carry out the nurse treatment that residents do not. Quality of care was found to be equal if not better in certain work requirements. Improved communication with patients, shorter waiting periods and length of stay were seen to contribute to overall higher patient satisfaction levels with nurse practitioner treatment.	Further higher quality research is required to confirm and update findings.

Figure 1

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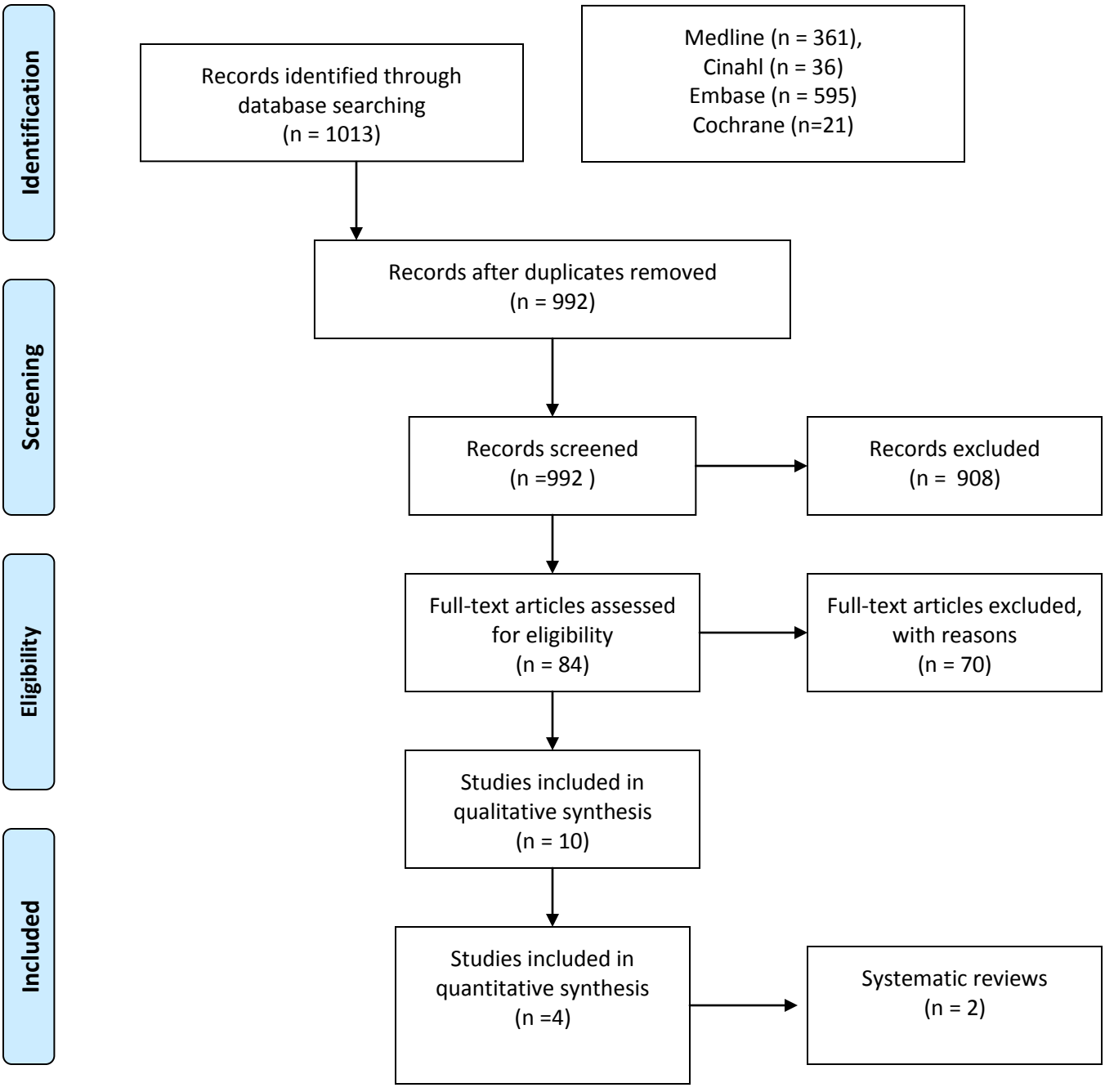
Figure 1. Systematic review Search Flow Diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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